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An Assessment and Awareness about adulteration in Milk and Milk Products and its Effect on Human Health in Delhi

V.K. Tiwari[1], Anis Bandopdhyay[2], M.Bhattacharya[3], Sherin Raj[4], K.S. Nair[5]
1&3 Professor,
2 Ex-MD Student,
4 Assistant Research Officer,
5 Assistant Professor,
National Institute of Health & Family Welfare, New Delhi, INDIA
vktiwari.nihfw@gmail.com, sherinraj@gmail.com

ABSTRACT:
The present research was conducted to study the implementation of the Prevention of Food Adulteration Act with special focus on adulteration in the milk and milk products in Delhi. Four Subdivisions, two each from district Northeast and South were taken on the basis of records. Testing was undertaken to find out the level of adulteration in milk samples collected from selected Subdivisions in the Delhi State. It was followed by interviewing of the shopkeepers about their awareness and knowledge about the Act. Opinion about the problem of adulteration in milk and milk products and their awareness about the PFA Act were also gathered through Focus Group Discussion (FGD).
Key words: Awareness, Adulteration, Milk and Milk Products, PFA Act

INTRODUCTION

Nutrition is now recognized as a major determinant of wide range of diseases of public health importance worldwide [1]. The report of the joint FAO/WHO expert committee on Food safety in 1983 says that 'illnesses due to contaminated food are perhaps the most widespread health problem in the contemporary world and an important cause of reduced economic productivity' [2]. Contamination deals with the unwanted deterioration of the quality of food; adulteration is defined as a process by which the quality of a product is reduced through addition of an inferior substitute or removal of vital products [3]. Further, expansion of food processing units throughout the country, have resulted in many processed foods having preservatives, additives and other chemicals resulting in long term and short term hazards to health [4]. The first statistical figure regarding the level of food adulteration in India was given in reports (part I and part II) of the Food Adulteration Committee of the Central Advisory Board of Health, in 1939 and 1943 [5]. After independence, in 1954, the country had the first comprehensive and uniform legislation on prevention of food adulteration for the whole nation. The PFA Act, and the rules thereof, have had further amendments in 1976, giving the central government powers to appoint its own public analysts and food inspectors. Currently the focus of regulatory work for PFA in the country depends on a system of inspections and penal action, where samples are taken and tested in laboratories for adulteration [6].

In September 1999, reports of sale of synthetic milk and milk with urea, in and around Delhi caused ripples among the public health authorities of the State [7]. In February 2004 with fresh reports of sale of "synthetic milk', the Zee Telefilm made an attempt to expose the manufacturing of synthetic and adulterated milk in the outskirts of the state [8]. In the series of reports, Centre for Science and Environment in February 2003 claimed the presence of extremely harmful pesticides in popular brands of bottled water sold in Delhi and Mumbai and high levels of pesticides and insecticide in a dozen of popular soft drinks brands, including Coco Cola and Pepsi [9]. Among the various food items adulterated, studies have shown that milk and milk products are among the major food items to be adulterated most commonly. In the study conducted in Coimbatore reveals that the extent of adulteration in buffalo milk was found to be 36.74%, and that of cow's milk was 29.27%. The extent of adulteration of milk in general was found to be 33.33 % [10]. An analysis of food items in the Hisar district of Haryana revealed that maximum adulteration was found in milk products (34.07%), followed by cereals and their products (19.77%), spices and condiments (18.68%), pulses (14.29%) and miscellaneous food items (13.19%) [11]. In another study, it analyzed different food items in Uttar Pradesh for adulteration after conducting two surveys, in which milk was found to be the most frequently adulterated commodity. About 33.8% of samples in first survey and 37% of milk samples of the second were found adulterated. Besides 14 –16% of butter and ghee were also found adulterated in the two surveys [12]. In another survey conducted across Delhi by the Prevention of Food Adulteration Department and reported that six samples of vanaspati ghee were found to be of substandard quality. Moreover, in several samples palm oil was being sold as vanaspati ghee [13]. The present study aimed at finding out the level of adulteration in milk and milk products in Delhi along with the awareness among various stakeholders.

MATERIALS AND METHODS

A two-staged stratified sampling design was followed. First out of nine, two districts of the Delhi State one from higher cases of adulteration, namely the North

East District and one from lesser cases of adulteration, namely the South District, were chosen for the study based on PFA data on milk and milk products in the year 2001. From each selected District, two Sub-Division ie, a total of four Sub-divisions were selected in the study.

From each selected Sub-Division, ten Shopkeepers, Retailers/Vendors selling milk and/or milk products were selected randomly for their awareness about the PFA Act specifically regarding milk and milk products was assessed using semi-structured interview schedule. Thus, a total of forty Shopkeepers/vendors were selected for the study. One Focus Group discussion in each of the four Sub-division were held to understand public perceptions regarding the magnitude of problem of food adulteration, especially for milk and milk products, the laws related to adulteration, provisions of the PFA Act, the role of consumers etc. To get an independent view on the extent of problem of adulteration of milk in the State of Delhi, 47 samples of milk were bought from four selected Subdivisions of the State and were analysed for various qualitative and quantitative tests to get an idea of prevalence of gross adulteration in milk samples sold in the State. Out of total 47 samples, 17 were mixed,5 were double toned,11 were full cream and 14 were toned. Eleven to twelve samples were drawn from each of the four subdivisions.

The milk samples thus bought were both in loose and in packed forms. They were bought from fixed outlets like Mother Dairy and DMS outlets, from retailers selling milk along with other food products, from wholesalers i.e. independent dairies and also from vendors selling loose milk. The samples were transported from the field in ice-lined box. Formalin was not used as a preservative (as indicated in the PFA Act) since one of the qualitative tests analysed the presence of formaldehyde as an adulterant in the milk samples. The tests were performed in the Reproductive Bio Medicine laboratory of the National Institute of Health and Family Welfare, Munirka, New Delhi. The Rose-Gottlieb method was used for fat solids. The lactometer, which is a specialized hygrometer, was used to determine the specific gravity of the milk samples. The lactometer was calibrated at 60° F. The total solids were calculated from Richmond's formula which is Total solids (%) =T=0.25G+1.2F+0.14 Where, G = lactometer reading (degrees) at 60 degree Fahrenheit and F = Fat (%). Non-fatty solids (NFS) = Solids non-fat **(SNF) = T - F** .For routine purposes, the figures are usually reported to the nearest 0.05%. (David Pearson, sixth edition) [14]. Tests were carried out for detection of presence of various common adulterants in an appreciable level in the milk samples. For this a kit (LK-1000) developed by the National Dairy Development Board and marketed by the Mother Dairy was used. This kit works on the principle of perceivable colour changes seen on presence of a specific adulterant in a sample of milk on the addition of the reagent/reagents and other simple procedures. The kit tested presence of substances like urea, ammonia, sugar, starch, glucose, salt, neutralizer, nitrates, hydrogen peroxide, formalin as adulterants in milk samples. Data was analysed with SPSS software according to given objectives. Content analysis technique was used to analyze information received from vendors etc.

FINDINGS AND DISCUSSION

1. *Analysis of Secondary Data*

Trend in Milk and Milk Products Examined

It is observed from the limited available data provided by PFA Directorate (Table 1) shows that an increasing number of samples are being drawn over past years for these items. The highest number of samples drawn was in 1999, which coincides with the fact of sell of synthetic milk in the State. The problem of adulteration in milk ranged from about mere 12% in 1995 to up to 50% in 1996. On year wise comparison, the level of adulteration in milk in the State was lower than that of the whole country, barring the exception of the year 1996. The data indicates existence of food adulteration and sample testing by the PFA Directorate. For milk products the level of adulteration has ranged from 7% to 14% for the year 1995 to 2002. Moreover, if we compare the number of samples of milk and milk products drawn expressed as a percentage of total of number of samples drawn we find that 9.7 % of the samples drawn in 1999 were of milk products and 13.6% of the samples were of milk. The comparative figure for the same in the whole country was 6.1% for milk and 4.81% for milk products. Thus, it can be concluded that a lower rate of adulteration found was not due to a smaller sample drawn but was perhaps due to lesser level of prevalence of adulteration in these two products in the State of Delhi [15]. It may be observed from table 2 that the level of adulteration found also varied from mere 12% in the northwest district to about 48% in the northeast district. When we compare the same parameters for the year 2002 it is found that the level of adulteration found ranged from 16% in the central district to 50% in the district south of the State of Delhi. In this year also there was a trend of decrease in the level of adulteration as the number of samples increased. The situation of the problem and the status of implementation were quite similar for butter, ghee, ice cream and others milk products as observed from table 3. On an average about 30 samples were drawn of these food items during the year of 2001 and about one tenth of them were found adulterated. It was also evident that a greater number of milk products were drawn for analysis as compared to that milk samples in the same year. As a result as

discussed earlier, it was seen the level of adulteration found was also low for these items as compared to milk.

2. ***Level of Adulteration in Milk - Results of Analysis by the Researcher***

a) ***Type of Adulterants in Milk***

It was found that the number of samples that contained at least one type of adulteration were 15 out of 47 samples, that means about 32% of the samples were adulterated by some or other chemical adulterants. No single sample contained urea or ammonia as an adulterant. Moreover, the adulterant found in most samples was glucose (6 samples), followed by salt (5 samples) and sugar (4 samples), which though by definition are adulterants, are less or not harmful to human health. 3 samples contained Neutralizer. All sort of outlets covered in the sample ie Vendor, Fixed Outlet, Amul milk, DMS milk, Mother Dairy Milk. Retailers had either of four substances. Simple addition of sugar, glucose and salt to enrich the taste of milk might have been the motive behind these adulterations.

b*) Quality of Milk*

The PFA Act and rules lays down the standards of minimum fat content and solids not-fat in milk, on the basis of which a sample is declared adulterated or not (Table 4). Quality analysis of the milk samples was done for determination of fat content (%), solid not fat (SNF) content and specific gravity. The table 4 shows the findings of milk quality analysis, i.e. fat content and solid non-fat content of the milk samples analysed. The values in each column marks the Minimum level of fat content (%) in milk prescribed for each category of milk by the PFA Act 1954, below which a sample is defined as adulterated. Thus from the results obtained it is revealed that in ten out of seventeen the samples of mixed milk had fat content below the prescribed limit of 4.5%. On the contrary, in case of double toned milk only one of the samples were having fat content less than the prescribed limit of 1.5%. Two samples of toned milk and three samples of full cream milk were having fat content less than the prescribed limit respectively. This gives a very high percentage of adulteration level for the samples as far as fat content is concerned. Sixteen (34.04%) out of 47 samples were found having less than prescribed amount of fat content that is much higher than the level of adulteration (23.83%) found in milk in the State during the year 2002.

Table 1. Year wise percentage of samples examined and found adulterated

Year	Butter, Ghee, Ice cream & Milk product			Milk		
	Examined	Adulterated	%	Examined	Adulterated	%
1995	153	18	11.76	47	6	12.77
1996	206	19	9.22	150	78	52.00
1997	122	17	13.93	58	17	29.31
1998	44	3	6.82	115	17	14.78
1999	217	30	13.82	305	50	16.39
2000	235	33	14.04	289	49	16.96
2001	279	32	11.47	212	54	25.47
2002	212	26	12.26	193	46	23.83

Source: Report of Implementation of PFA, Govt. of Delhi

Table 2. District wise Sample of Genuine and Adulterated Milk in Delhi for the year 2001 and 2002

District	Genuine		Adulterated		Total		% Found adulterated	
	2001	2002	2001	2002	2001	2002	2001	2002
New Delhi	5	6	2	3	7	9	28.57	33.33
North	23	12	4	4	27	16	14.81	25.00
East	16	18	7	7	23	25	30.43	28.00
South	6	4	1	4	7	8	14.29	50.00
Southwest		4		1		5		20.00
Central	36	30	7	6	43	36	16.28	16.67
Northeast	10	12	9	8	19	20	47.37	40.00
Northwest	36	28	5	6	41	34	12.20	17.65
West	26	33	19	7	45	40	42.22	17.50
Total	158	147	54	46	212	193	25.47	23.83

Note: the number of samples found Misbranded was zero for the year.

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Table 3. District wise Distribution of Adulterated Milk Products in Delhi for the year 2001 and 2002

Milk Products	Genuine		Adulterated		Misbranded		Total		Percentage	
District	**2001**	**2002**	**2001**	**2002**	**2001**	**2002**	**2001**	**2002**	**2001**	**2002**
New Delhi	23	27	4	8			27	35	14.81	22.86
North	68	38	6	3			74	41	8.11	7.32
East	25	33	1		1	1	27	34	7.41	2.94
South	28	17		1			28	18	0.00	5.56
Southwest	13	8			2	3	15	11	13.33	27.27
Central	22	11	4			1	26	12	15.38	8.33
Northeast	8	14	4	1	1	3	13	18	38.46	22.22
Northwest	32	14	4	1	1		37	15	13.51	6.67
West	28	24	2	2	2	2	32	28	12.50	14.29
Total	247	186	25	16		10	279	212	11.47	12.26

Table 4. Fat Content found in different type of Milk Analysed

Type of Milk	Fat Content							Total
	Milk Fat (Minimum percent)	***Milk solids-not fat (Minimum percent)***	**< 1.5**	**1.5 to <3**	**3 to < 4.5**	**4.5 to < 6.0**	**>= 6**	
Mixed & Standardised (Raw, pasteurized, boiled, flavoured and sterilized)	4.5	8.5		3*	7*	5	2	17
Double toned (Pasteurized, flavoured and sterilized)	1.5	9.0	1*	4				5
Full cream (Pasteurized and sterilized)	6.0	9.0				3*	8	11
Toned (Pasteurized, flavoured and sterilized)	3.0	8.5		2*	11	1		14
Total			1	9	18	9	10	47

**-Denotes fat content amounting to adulteration as per PFA Act, 1954*

Table 5. Solid Not-Fat Content found in various types of Milk Analysed

Type of Milk	SNF content (%)			Whether Adulterated as per Quantitative Tests		Total
	< 8.5	**8.5 to < 9.0**	**> 9.0**	**Adulterated**	**Genuine**	
Mixed	4*	3	10	10 (58.8%)	7 (41.2%)	17
Double toned	2*	1	2	2 (40.0%)	3 (60.0%)	5
Full cream		1*	10	3 (27.3%)	8 72.7%)	11
Toned	3*	8	3	5 (35.7%)	9 64.3%)	14
Total	9	13	25	20 (42.6%)	27 57.4%)	47

** - Denotes solid not-fat content amounting to adulteration as per the PFA Act, 1954*
(%) - Row percent

On working out the amount of solid not fat from Richmond's formula, using the fat content and lactometer reading for the particular sample it was found and presented in Table 5 that about ten samples (21.27%) were falling below the prescribed standards given in the PFA Act, 1954. Four samples of mixed milk, two samples of double toned milk and three samples of toned milk were found having less 8.5% SNF, the minimum percentage prescribed by the PFA Act, 1954. On the contrary only one sample of full cream milk was having SNF of less than the prescribed minimum limit of 9%.

Total Adulteration – Result of Adulterant and Milk Quality Tests Combined.

On taking account of both the parameters, i.e. content of fat percentage and solid not fat percentage, it was found that twenty samples out of forty-seven analysed were substandard and thus was adulterated. This gives a high figure of about 43% of adulteration for these two districts combined.

On the whole, it was found that 15 samples were adulterated due to presence of external substances and 20 samples were found adulterated as per standard content of fat and non fat norms. The number of samples found adulterated by at least one means was found to be 24, indicating much overlap i.e. 11 samples were below standard both by quality and content standards. Thus the overall adulteration percentage found was alarmingly high of 51.1%. This is much higher than the country average of 23.7% for milk (1999) and also that of State average of 23.83% in the year 2002. But when we compare the above value with the level of adulteration in milk found in the selected two divisions combined for the year 2002 (i.e. about 42.34%) we find this quite comparable.

Adulteration in milk products in other cities was also studied by the National Institute of Nutrition, Hyderabad (1996-1997) a total of 158 samples of packaged and loosely sold milk from three cities, namely, Delhi, Calcutta and the twin cities of Hyderabad and Secunderabad were analysed for the presence of commonly used preservatives – formaldehyde, hydrogen peroxide, Thiocyanates and neutralizers (carbonates). Out of them, 80 samples from Delhi were also tested for the presence of starch, sugar, the amount of urea and fat, and for the presence of foreign fat- the supposed ingredients of 'synthetic milk'.

Out of the total 28 milk powder samples nearly 61% of the samples did not conform to the ISI limits for total solids content. About 18% had a higher ash content and alkalinity of ash as compared to the prescribed limits. 10.7% of the samples had a higher moisture level than the PFA limit. Starch was detected in six (21%) milk powder samples sold loose. Sucrose was detected in 26 (93%) of the total samples carbonates (neutralizers) in 11 (39%) samples. Starch was present in the range of 6-13% and sucrose 5-38%. One of the samples contained Gentamicin, which was suspected being added to preserve the milk. In the milk samples from Delhi, the urea content was found to be normal range of 7.1-25.8mg/100ml. Starch and sugar were detected in two samples each. The refractive index of the extracted fat was found to be higher than normal in seven samples indicating the presence of foreign fat. Eighteen samples (22.5%) samples tested positive for neutralizers (carbonates). None of the samples were found to have all the supposed ingredients of 'synthetic milk' [16,17].

3. *Awareness among the Shopkeepers and Retailers about the Prevention of Food Adulteration (PFA) Act*

A survey about the awareness about the PFA Act among the shopkeepers, retailers and vendors was undertaken. Forty shopkeepers were selected for the study from the four selected subdivisions.

Awareness about Licensing

On asking whether they have got license to sell food articles about more than half (60%) of the respondents said they had so, where as about one third said they don't possess one. Ten percent of respondents said that they were unaware of the licensing status of the shop/retail outlet. While none of the vendors said they possess a license to sell their food articles about 75% of the retailers said they do possess a license for sell of food articles.

Awareness about any Legislation related to Food Adulteration

It was found that the majority (70%) of the shopkeepers and vendors were aware of any legislation regarding prevention of food adulteration**.** It was found while only 40% of the respondents who were illiterates, were aware about any legislation regarding prevention of food adulteration, about 88% among the respondents who had education up till graduation were aware of the same. About 55%, i.e. about more than half the respondents did not have any knowledge about the main aspects of the law.

Awareness about adulteration in Milk

About 75% of the shopkeepers and vendors agreed on the fact selling of milk with added water is indeed adulteration of milk and about 78% percentage also perceived selling of sour milk as adulteration. It was also found that there is a very low level of awareness about misbranding among the respondents as only 37.5% felt that selling milk in a sealed poly bag with

no label is illegal. Also lesser people termed the conditions of nonfatal adulteration as unlawful. 82% of vendors were aware that selling milk that contains substance that is harmful to human health is adulteration. Four shopkeepers/vendor did not respond.

Awareness about Sample lifted by the Food Inspectors

About 38% of the respondents claimed that the Food Inspectors have taken a sample of food in the previous year. On comparing between the two districts, a much better functioning was evident in the south district which is the best part of the city. About 53% of the respondents of the south district said that the Food Inspectors took samples from them in the past one year as compared to only 23% in the northeast district.

Awareness among Consumers regarding Adulteration in Milk

The four focus group discussions were carried out in each of the selected subdivision. to know the awareness and knowledge of the consumers from each of the four sub divisions about the problem of food adulteration in milk and milk products, type of adulteration magnitude of it, the PFA act, the role of consumers and finally their satisfaction with the working of the PFA department.

Perception about Adulteration in Milk and Milk Products

The group members felt that adulteration of food articles is very common phenomenon and milk and milk products are no exception. There was lack of agreement on the extent of the problem in regard to milk and milk products, while group members from Seema Puri felt that these two items are most adulterated, group members from Hauz Khas and Defence colony opined that the problem of adulteration is same for all food articles and there is no special threat of the same in milk or milk products. The difference of perception was also observed in an earlier study. Study conducted in Udaipur reported that most housewives (65%) belonging to high and middle-income groups looked for quality of products, its brands, if any, while purchasing. On contrary the low-income group always looked for quantity, giving less or no importance on quality [18].

Awareness about type of Adulteration in Milk and Milk Products

The different groups had varied opinion. While groups from Shahdara and Defence Colony felt milk with water added to it, is very part of their daily routine, the rest of the two (Seemapuri and Hauz Khas) opined that because they buy packed milk, adulteration of milk is not that much a problem in their locality. As for adulteration in khoa, no specific point came out except that majority of the members of the groups opined that retailers and shopkeepers add 'maida' and other things in khoa. The members of the Defence Colony and Hauz Khas groups' felt the paneer they get in the nearby market is not that adulterated. On the contrary the group members of Shahdara was particularly worried with the quality of paneer they get from the local market. The group from Seema Puri gave a mixed response. Ghee was opined by the groups is grossly adulterated. According to them desi ghee is a myth. Most commonly, according to them, ghee is adulterated with 'Dalda' and other vegetable oils. There was general consensus that sweets are adulterated. The members of the groups were not very much aware of the problem in ice-creams, more over they felt that because ice-creams comes in packs and are sold with popular brand names the chances of adulteration is much less. It is also evident that the perception of adulteration in foods as a problem varied with age and other socio-demographic features. It was seen the aged population and the married women were most concerned with the problem of adulteration in Delhi and its magnitude.

A study conducted to find out the awareness on food adulteration among people belonging to different socioeconomic groups of Delhi. It was found that economic status were having no significant influence on the level of knowledge and awareness in the post exposure visits [19].

Awareness about Effect of Adulteration in Milk Products on Human Health

It was observed that the knowledge about the specific effects of adulteration of milk on human health was very low. Some said that pesticides in milk could cause cancer. The group from Hauz Khas didn't consider addition of water in milk as a health hazard but rather considered it as a financial loss, while group from Defence colony felt that even adding of water is harmful to health as it deprives one of nutrition.

Knowledge and Awareness of Simple Tests to Detect Common Adulteration in Milk and Milk Products.

The awareness about simplest method of detecting adulteration in milk was quite low. Only three young persons in the Seema Puri FGD mentioned about lactometer, as did one elderly gentleman in the the FGD conducted at Hauz Khas.

Awareness about any Legislation/Law for Prevention of Food Adulteration

There was a low awareness among the groups regarding legislation related to prevention of food adulteration. Two members among the elderly group from Hauz Khas knew about the PFA Act and three

others from the same group were aware about the Consumer Protection Act. Only one member of the group was aware of the details of the PFA Act regarding whom to complain and the process of sample collection and analysis. The groups from Shahdara and Defence colony were totally unaware of any legislation regarding prevention of food adulteration. The young group from Seema Puri had some knowledge about the PFA Act. Newspaper was the major source of their awareness regarding food laws.

Not many of the members were aware about whom to complain, though the members of the elderly group was aware of the SDMs and they had the idea that complaint should addressed to the consumer protection cell (district consumer redressal forum) or other PIL cell. Members of the other groups were totally unaware of whom to complain, others had the idea that complaint to be made to the MCD department. Only two young people from Seema Puri mentioned about the PFA department (which they have come to know from newspaper)'. The consumers were unaware of how to make complain regarding adulteration of food. None of them had any idea of exact penalties under PFA Act. The groups were unaware about the role of consumers. Satisfaction with the Functioning of the PFA Department in the Localities varied. Majority said that they are unaware of its functioning so they cannot comment on the same. Members of the elderly group from Hauz Khas felt that nothing is functioning and the whole system is corrupt. Other groups (group of parents and housewives) pretty unaware of the functioning of department in their locality.

LIMITATIONS OF THE STUDY

During the data collection, many constraints were faced in obtaining information. The PFA Directorate did not provide most recent records of sample collected and found adulterated etc due to administrative reasons. Some of shopkeepers were very aggressive and denied to cooperate. The tests done on milk samples were rapid and qualitative only. They were not substitute for the standard analysis followed in authorized laboratories.

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